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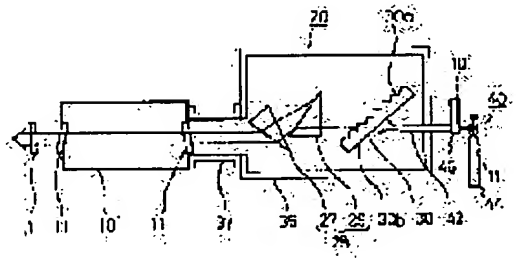
(71)Applicant : KOMATSU LTD

(72)Inventor : WAKABAYASHI OSAMU
KOBAYASHI YUKIO
KOWAKA MASAHIKO

(54) NARROW-BAND OSCILLATION EXCIMER LASER EQUIPMENT AND ITS PURGING METHOD

(57)Abstract:

PURPOSE: To eliminate the fluctuation of oscillation wavelength of output laser light due to the change of refractive index of gas on the grating surface, and restrain heat generation of optical elements, by arranging an introducing port of clean gas for purging on the rear side of the grating, and preventing the clean gas from flowing on the trench surface of the grating.



CONSTITUTION: The title equipment is constituted of a front mirror 1, a laser chamber 10 for oscillating laser, and a narrow bandwidth equipment for narrowing the laser bandwidth, which equipment is constituted of a prism beam expander 25, a grating 30, a cabinet 35 and a clean gas equipment 40 which blows out clean gas from a clean gas introducing port 42 via a flowmeter 46 form a clean gas cylinder 44. The clean gas introducing port 42 is arranged on the rear side 30b of the grating 30. The gas flow is not generated on the trench surface 30a of the grating 30, so that the fluctuations of the center wavelength of output light and a beam profile do not occur. The inside of a narrow bandwidth box 35 and the inside of a pipe 37 are filled with the clean gas.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to amelioration of the narrow-band oscillation excimer laser equipment especially used as the light source for contraction projection aligners, and its purge approach with respect to narrow-band oscillation excimer laser equipment and its purge approach.
[0002]
[Description of the Prior Art] Conventionally, with the technique currently indicated by Japanese Patent Application No. No. 129392 [one to], JP,1-123238,A, JP,1-143372,A, etc., two or more etalons or beam expanders, and gratings are performing narrow-band-ization. Since a narrow-band-ized component is damaged and it shortens the component life by dust, oxygen, etc. in air in the thermal load of a narrow-band-ized component is large and operating narrow-band laser in the long run, in order to reduce a thermal load or to prolong a narrow-band component life, the pure purge gas is directly sprayed on the optical element like drawing 8 .
[0003]
[Problem(s) to be Solved by the Invention] However, if a grating was used as a narrow-band-ized component and a clarification gas was sprayed on the slot front face of a grating, in order that the gas refractive index on the front face of a slot of a grating might change, it discovered that fluctuation occurred as shown in the oscillation wavelength and the beam profile of laser at drawing 9 and drawing 10 . Since it generated at random, the fluctuation of this oscillation wavelength was not able to stabilize oscillation wavelength below to fluctuation. Moreover, since exposure became impossible to homogeneity when exposing, if a beam swings, as the light source for steppers, it was unsuitable.
[0004] This invention aims at offer of the narrow-band oscillation excimer laser equipment especially used as the light source for contraction projection aligners, and its purge approach with respect to narrow-band oscillation excimer laser equipment and its purge approach paying attention to the above-mentioned conventional trouble.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, it has the means which encloses said narrow-band-ized component with a housing, a means to purge the inside of said housing with a clarification gas, and a means by which the flow of a clarification gas does not take place in the slot front face of said grating by purging, in the narrow-band laser which has arranged the grating at least as a narrow-band oscillation.
[0006] Thus, filters, such as HEPA, are penetrated, the gas which is not reacted and absorbed to laser beams, such as inert gas, such as nitrogen or helium, or air, is made into a clarification gas, and when the clarification gas does not spray the slot front face of a grating, fluctuation of the oscillation wavelength of laser and a beam profile is lost.
[0007]
[Function] According to the above-mentioned configuration, since he is trying not to cause the flow of a clarification gas on the slot front face of a grating, change of the refractive index of the gas on the front

face of a grating is lost, and the fluctuation of the oscillation wavelength of an output laser beam and fluctuation of a beam profile are lost. Moreover, when a thermal load sprays a clarification gas on the front face of a big optical element, generation of heat of an optical element can be suppressed.
[0008]
[Example] Below, with reference to a drawing, it explains at a detail about the example of the narrow-band oscillation excimer laser equipment concerning this invention. Drawing 1 is the whole block diagram showing the 1st example of the narrow-band oscillation excimer laser equipment of this invention. In drawing 1 , narrow-band oscillation excimer laser equipment consists of the front mirror 1, a laser chamber 10 which excites laser, and narrow-band-ized equipment 20 which narrow-band-izes laser. The laser chamber 10 consists of the electrode, the window 11, and chamber 12 which are not illustrated. Narrow-band-ized equipment 20 serves as the prism beam expander 25, a grating 30, and a housing 35 from clarification gas equipment 40. The prism beam expander 25 and the grating 30 are enclosed with the housing 35. The prism beam expander 25 consists of the 1st prism 27 and the 2nd prism 29. The housing 35 is formed with the narrow-band box. The inlet 42 of the clarification gas from clarification gas equipment 40 is arranged in background 30b of slot surface 30a of a grating 30.
[0009] The narrow-band-ized method of this example is a method which combined the prism beam expander 25 and the grating 30, and the grating 30 has become RITORO arrangement. The 1st prism 27, the 2nd prism 29, and a grating 30 are covered with the narrow-band-ized box 35, and are connected with the laser chamber 10 by tubing 37. In clarification gas equipment 40, a clarification gas blows off from the inlet 42 of a clarification gas through the clarification gas chemical cylinder 44 to the flowmeter 46. The inlet 42 of a clarification gas is arranged in background 30b of a grating 30, and the inside (optical path between a narrow-band-ized box and a window) of the narrow-band-ized box 35 and tubing 37 is filled with a clarification gas by slot surface 30a of a grating 30, without gaseous flow starting.
[0010] Next, actuation is explained in the above-mentioned example. If the inside of the laser chamber 10 and narrow-band-ized equipment 20 are filled with the clarification gas of the gas which does not react to laser next, discharge excitation is carried out within the laser chamber 10, and after laser is narrow-band-ized with narrow-band-ized equipment 20, it will be outputted from the front mirror 1. At this time, since gaseous flow does not occur in slot surface 30a of a grating 30, fluctuation of the main wavelength of output light and a beam profile is lost. Moreover, since the perimeter of a window 11, prism 27 and 29, and a grating 30 is filled with the clarification gas, the life of the prism beam expander 25 of a narrow-band-ized component, a grating 30, and a window 11 is prolonged by leaps and bounds.
[0011] In addition, whenever [sealing / of this narrow-band-ized box 35 or tubing 37] is good at extent from which that interior is filled with a clarification gas. What is necessary is just to install the small exhaust port of a clarification gas, when whenever [sealing / of the narrow-band-ized box 35 and tubing 37] is made high. Although the inlet 42 of a clarification gas is installed in the side attachment wall of the housing 35 which counters tooth-back 30b of a grating 30 in this example, by what is limited to it, there is nothing, and as long as it is the tooth-back side of grating 30a, you may install in bottom plate 35a or superior lamella 35b of a narrow-band-ized box. There is inert gas, such as nitrogen gas and helium, as an example of a clarification gas. Moreover, when oxygen does not react with an optical element or does not absorb a laser beam, you may purge with the air which passed the HEPA filter.
[0012] Drawing 2 is the whole block diagram showing the 2nd example of the narrow-band oscillation excimer laser equipment of this invention, and the prism beam expander 50 of a narrow-band-ized method uses prism 25 and 27, the etalon 51, and the grating 30 with the 1st example. Since gaseous flow does not occur in slot surface 30a of a grating 30 like the 1st example in this case, fluctuation of the main wavelength of output light and a beam profile is lost. Thus, if it is the narrow-band-ized method which has arranged the grating at least, without being caught by the above-mentioned example as a narrow-band-ized method, it is good anything. Moreover, oblique incidence arrangement is sufficient as a grating.
[0013] Drawing 3 is the whole block diagram showing the 3rd example of the narrow-band oscillation excimer laser equipment of this invention, and the 1st example indicates the example which added walls

56 and 57 to be modification of the location of the inlet 55 of a clarification gas. The location of the inlet 55 of a clarification gas is arranged to the slot surface 30a side of a grating 30, and the wall 56 is arranged in the location which does not bar an optical path between the prism beam expander 25 and a grating 30. Thus, as long as it arranges walls 56 and 57 so that an optical path may be enclosed, as long as the location of the inlet 55 of a clarification gas is the outside, it may be arranged anywhere. Since gaseous flow does not occur in slot surface 30a of a grating 30 like the 1st example in this case, fluctuation of the main wavelength of output light and a beam profile is lost.

[0014] Drawing 4 is the whole block diagram showing the 4th example of the narrow-band oscillation excimer laser equipment of this invention, and the prism beam expander 40 uses prism 25 and 27, the etalon 51, and the grating 30 for the narrow-band-ized method like the 2nd example with the 3rd example. As long as it arranges walls 56 and 57 so that an optical path may be enclosed also in this case, as long as the location of the inlet 55 of a clarification gas is that outside, it may be arranged anywhere.

[0015] Drawing 5 is the whole block diagram showing the 5th example of the narrow-band oscillation excimer laser equipment of this invention, and the 3rd example shows the example which the location of walls 61 and 62 changed. It divided into the room 63 which contains a grating 30 with a wall 61, and the room 65 containing the prism beam expander 25, and the location of the inlet 64 of a clarification gas is arranged to the room 65 side containing the prism beam expander 25. Since gaseous flow does not occur in slot surface 30a of a grating 30 like the 1st example in this case, fluctuation of the main wavelength of output light and a beam profile is lost. However, it cannot be overemphasized that the room 63 which contains a grating 30 also in this case is filled with inert gas.

[0016] Drawing 6 is the whole block diagram showing the 6th example of the narrow-band oscillation excimer laser equipment of this invention, and the location of the inlet 71 of a clarification gas is changed with the 1st example. In this case, the location of the inlet 71 of a clarification gas is made into the location which sprays a clarification gas on 2nd surface 27b of the 1st prism 27. Moreover, in order to cool the 1st prism 27 at this time, you may make it the location on which a clarification gas is sprayed so that 1st page 27a of the 1st prism 27 or both sides 27a and 27b may be cooled. Since the 1st largest prism 27 of a thermal load can be cooled by doing in this way, while being able to suppress change of the spectral line width of an output laser beam, or beam width, a life can be prolonged by leaps and bounds.

[0017] In addition, in the 1st example and the 2nd example, as a result of changing the flow rate of a clarification gas and measuring fluctuation of wavelength and a beam profile, when it was 5 or less l/min of flow rates, the fluctuation of wavelength and a beam profile did not take place. Moreover, as a result of measuring the cleanliness of the narrow-band-ized box 35 with a particle counter, when it was 0.2 or more l/min, the pure enough thing became clear in the narrow-band-ized box 35. Furthermore, in the examples 3, 4, 5, and 6, as for the fluctuation of wavelength and a beam profile, even 5 or more l/min even of flow rates did not happen.

[0018]

[Effect of the Invention] As explained above, according to this invention, a narrow-band-ized component is enclosed with a housing, damage on the narrow-band-ized component produced from **, such as dust and oxygen, by purging said housing with a clarification gas is lost, and the life of a narrow-band-ized component is extended by leaps and bounds. Moreover, exposure nonuniformity is lost, when fluctuation of oscillation wavelength and a beam is lost, therefore the stability of oscillation wavelength improves and it is used as the light source of a stepper, in order to make it not cause the flow of a clarification gas on the slot front face of a grating. Furthermore, since generation of heat of the big optical element of a thermal load can be suppressed, change of spectral line width and change of a beam profile can be suppressed, and an optical element life also improves. For this reason, the laser optimal as the light source for steppers is obtained.

[Translation done.]